Information Leakage in Stock Options Markets

An Honors Thesis (HONRS 499)

By

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Abstract

Information is the key to any successful market. In equity markets, the possession of undiscovered or unpublished information can lead to abnormal returns. This study attempts to determine if there is a relationship between option volumes and earnings surprises. By examining option volumes leading up to company earnings announcements for the 100 companies in the S&P 100 Index over the five year period from 2008 to 2012 and comparing these figures to the earnings surprises of the firms for each announcement period, this study aims to determine if option volumes have predictive ability for company performance. Ultimately, results were not entirely conclusive. Call option volumes were only 40% successful in predicting an earnings surprise, but put option volumes were 62% effective. Utilizing both calls and puts to predict earnings surprise directions was only 25% predictive. These results suggest that unusual option volume is not a reliable predictor of earnings surprise direction.

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Author's Statement

Derivative investment vehicles play an important role in an efficient market. They bring information about expected volatility, timing, and price changes to the entire audience of market participants. By participating in derivative markets, investors communicate, through price changes and volume, expectations about future underlying security movements. When analyzed properly, the information available in derivative markets has the potential to indicate major market news before it is announced.

This paper utilizes historical market information about derivative investment vehicles (call and put options) to determine if this information could be used to effectively predict the way in which markets will move in the future. The question posed is as follows: "Do major volume changes in call and put option markets communicate the information of well-informed investors before official company news releases?" That is to say, do major market players (such as investors with better information, better models, or inside information) make large moves in derivatives markets that can be read by less well-informed investors to achieve abnormal returns?

By answering such a question, one arrives at important conclusions regarding the profitability of such strategies. But it also reveals information about the ways in which markets work and how information is communicated in a market through volume instead of the traditional price mechanism. Such information is of interest to market participants (both institutional investors and more advanced retail investors), market regulators, and academics studying efficient markets. A leakage of information through volumes indicates an inefficiency that can be capitalized upon for profits.

1. Introduction

In any market, the availability of information is the key to efficiency. Much time is devoted in finance principles courses to examining the types of market efficiency, all of which are dependent upon the availability of information. More information with better delivery makes for more efficient markets. In this study, it was assumed that markets are not perfectly efficient. The existence of asymmetrical information between market players and the lag in time between the disclosure of that information and the actions taken by market participants to adjust to that information allows for market players to capitalize on profit opportunities. If one can find a way to become aware of the existence of information asymmetries before they become noticed by others, then he or she can realize abnormal returns.

This study examines the behavior of stock options volumes leading up to company earnings announcements. For the 100 companies comprising the S&P 100 index historical put and call option volumes were collected from The Bloomberg from 2008 through October of 2011. Along with this historical option volume data, earnings surprises for each company for the time period were collected from The Bloomberg as well. These surprises give the percentage deviation from the analyst consensus estimate for period earnings for each company in the index over the time period. By comparing the behavior of volumes in the trading days preceding an announcement to the earnings surprise figures for that particular period, this study looks to find relationships between the magnitude of these volume changes and the magnitude of surprises.

The findings in this report have many applications. Most obviously, the relationship between options volumes and earnings surprises can be used to earn abnormal returns. Investors are constantly looking for market advantages, and discovering information before it is made public through the options market can be profitable. This information can also be used to help find evidence of illegal insider trading. If evidence of insider trading can be found by examining options volumes, then the SEC and the

CBOE can better prevent illegal insider trading which exacerbates the problem of asymmetrical information in markets.

2. Literature Research

Many studies have been undertaken to understand the behavior of information in markets. There is a great monetary incentive to understand these relationships – if one can gain information ahead of the majority of the marketplace, he or she can trade on that information to realize abnormal returns. According to Heidle and Li, "the evidence indicates that the recommending market makers react well before the public announcements and before other market makers" (Heidle & Li, 2005). Their study found strong evidence that market makers change their pricing behavior before analyst recommendation changes – indicating that the market makers had become aware of the intended change before it became public information and then used this information to earn an abnormal return. A 2010 study by Hayunga and Lung found "evidence that option investors trade in front of the analysts' revision. Further, option traders correctly forecast whether the revision will be an upgrade or a downgrade" (Hayunga & Lung, 2010). In "The Information in Option Volume for Future Stock Prices" by Pan and Poteshman, evidence was found that "clearly rejects the null hypothesis that the stock and options markets are in a separating equilibrium with informed investors only trading in the stock market." Further, Pan and Poteshman went on to state that "Rather than a disconnection between the stock and the option markets, the predictability that we document appears to be driven by valuable nonpublic information which traders bring to the option market" (Pan & Poteshman, 2006).

Clearly, then, there is a body of literature that suggests that information discovery can occur by examining the behavior of market participants. By monitoring the behaviors of select groups, such as market makers or options traders, one can reliably predict future market events, such as analyst revisions or stock price movements. Perhaps the most important modern work on options volumes and

their link to earnings announcements is in Lee and Amin's 1997 study "Option Trading, Price Discovery, and Earnings News Dissemination." In this study, it was found that option traders on aggregate enter into more long positions before good earnings announcements and into more short contracts before poor earnings announcements (Amin & Lee, 1997). Lee and Amin have been referenced in most other studies that have taken place on information discovery in options markets in the last decade. Many of the methods used in this paper can find their roots in the study done by Lee and Amin.

Amin and Lee's study marks the most modern look at abnormal options volumes and the price discovery that takes place in options markets. Amin and Lee, do not, however, necessarily examine the relative predictive power and success rates of these abnormal option volumes to correctly determine the positivity or negativity of the earnings announcement. As such, the study misses an important potential source of revenue and information in the market.

Heidle and Li's 2005 study takes an important look at the role of insider information in markets. This study does not examine options markets, but it does examine markets in which privileged participants have information prior to its public release: market makers from the same recommendation-issuing brokerage houses for NASDAQ listed stocks. Heidle and Li find that, by measuring differences in observed volume against expected volume, one finds evidence of privileged trading by market makers who change their quoting behavior in anticipation of new announcement releases. The methodology of Heidle and Li's study is particularly important to this study, as they examine similar problems. In addition, Heidle and Li's examination of insider trading in particular is an important inspiration for this paper.

Pan and Poteshman's 2006 study echoes that done by Amin and Lee in 1997. Pan and Poteshman "examined the informational content of option volume for future stock price movements... to identify informed trading in the option market and to elucidate the process of price discovery" (Pan &

Poteshman, 2006). Like Amin and Lee, Pan and Poteshman found strong evidence of informed trading in options markets and evidence that stock prices lag option prices by weeks in some cases. Pan and Poteshman also confirm Amin and Lee's finding that this difference in prices is driven by nonpublic information rather than market inefficiency. Pan and Poteshman also performed a predictive power analysis to determine how well options could predict stock price moves. Pan and Poteshman's work is an important precursor to this study and an important confirmation of Amin and Lee's work.

The 2010 study by Hayunga and Lung examines options trading prior to financial analyst recommendation revisions. Again, Hayunga and Lung are looking for evidence of informed or insider trading in options markets prior to the relevant information's public release. Hayunga and Lung's findings are interesting because they find that option traders seem to be able to trade not only in the correct direction of an earnings revision, but to do so several days (up to five trading days) in advance, suggesting an ability by the traders to *forecast* the event, indicating either highly competent and savvy investors or some type of insider information leakage.

Finally, the 2010 paper by Jin, Livnat, and Zhang examines option volatility to predict equity returns. This paper found important evidence of the *type* of informed trading that was occurring in options markets. Jin et al.'s findings suggest that option market activity can predict announcements because option market participants have a "superior ability to process public non-scheduled information relative to equity investors" (Jin, Livnat, & Zhang, 2011). Most convincingly in support of this conclusion is the finding that even after major announcements, options markets tend to predict long-term returns for non-scheduled events.

This study draws on all of these previous studies. Primarily a throwback to Amin and Lee's 1997 paper and Pan and Poteshman's 2006 study, however, we look at option volumes specifically and their ability not to determine equity prices or returns, but to predict earnings surprises, directions, and magnitudes. This predictive power, then, should theoretically translate to predictive power over equity

price movements. Drawing on methodologies and findings regarding information discovery from all of the aforementioned studies, we look at the options markets for a five-year period from 2008 to late 2012 for the entire S & P 100 Index. Most importantly, this study arrives at a predictive ability score for a call option volume criteria test, a put option volume criteria test, and a combined put and call option volume criteria test for each company individually and for the index as a whole over the entire five-year period.

3. Hypothesis

The hypothesis in this study is that the behavior of stock options volumes can reliably predict the direction and magnitude of company earnings announcements. Superior information may be available to privileged market participants or superior investors before an earnings announcement is to be made, and those market participants will use this information to position themselves in the options markets to achieve magnified returns. For large earnings beats, one would expect a greater magnitude of change in call option volumes compared to smaller earnings beats. This is because for a large earnings beat, one would expect the respective call options to be *relatively more underpriced* than for a small earnings beats. Because the options are relatively more underpriced, the market participant will have greater incentive to purchase more call contracts, therefore increasing the call option volume in the run up to an earnings announcement for a large earnings beat by a greater amount. One would expect the same behavior in the put options market for earnings misses – a larger miss should be preceded by a larger increase in volumes in the put contracts market than one would expect to see for a smaller earnings miss. For earnings losses (defined in this study as earnings surprises of greater than -100%, where 100% is the full value of the consensus earnings estimate), one should expect, similarly, a huge increase in volume in the put market.

4. Methodology

Several methods were employed to collect, parse, and analyze the data for this paper. The data collection and analysis process required knowledge of Django and Python programming languages. This analysis platform allowed for easy data manipulation since the database utilized for this research contained over 240,000 data points and each company had different periods between announcement dates. The lack of uniformity between announcement dates posed a special challenge in analyzing the data. The use of programming to manipulate the data also served as a good introduction to quantitative analysis techniques popular with most modern high profile trading firms and funds.

4.1 Data Collection

Data was collected from The Bloomberg using both the Bloomberg Terminal and the Bloomberg Excel API (Bloomberg, 2012). The Bloomberg Terminal is an industry-standard financial information software suite that allows investors access to real-time and historical metrics, such as price and volume, for a wide array of financial products across virtually every traded market. The Bloomberg API, or application programming interface, is an Excel add-in that allows users to more easily draw data from The Bloomberg and manipulate it in a spreadsheet format in Excel. Historical company volumes for the companies of the S & P 100 were gathered by using the BDH formula in the Bloomberg Excel API. The formula is the Bloomberg Data History formula which retrieves historical end-of-day data for the user in an easy-to-use and manageable format. Earnings surprise numbers were gathered by manually exporting them from each company's earnings report page in the Bloomberg Terminal. These data were then compiled into excel spreadsheets for easy readability. After the completion of these spreadsheets, the data was again reformatted into text files and fed into a Django database.

4.2 Data Structure and Scripts

Structuring a database and writing a program to manipulate the data was an important part of this project and analysis. Building skills in programming, code literacy, and code-centric problem solving is

essential to modern data analysis and the modern practice of asset management and trading – especially at large banks or investment firms. The code and its processes which will be discussed in this section are available for viewing in the appendix to this paper.

As mentioned previously, the database was structured in Django with help from Alex Corn, a consultant and information security expert from Carnegie Mellon University. With his help, a database was constructed that contained fields for Company Name, Date, Put Volume, Call Volume, Announcement Date, and Earnings Surprise.

Once the database was structured, it was populated with the data from Bloomberg. This Bloomberg data was already formatted in-line with the structure of the database, converted to a simple text file, and then uploaded to the database. This ensured the accuracy and consistency of the data when transferring it from its raw form from Bloomberg into its final form in the database ready for manipulation.

With the database completed, actual analysis could begin on the data. The code for the analysis of the data will be of most interest to the audience as it is this code which is responsible for the results and manipulation of the data. The analysis code consists of several functions responsible for the various operations which were conducted on the data and one "master" function responsible for the bulk of the analysis and for directing the proper data to the proper functions, then retrieving the proper outputs and displaying them.

The "master" function was named "thesisAnalysis" and was passed two primary classes of data: 'analysisRun' and 'companies.' The function starts at the first company in the list (AAPL, in this case) and then sorts AAPL into 16 periods based on the announcement dates for the four-year period of data over which the study was conducted. Then, period-by-period, the function defines the control or nonevent period and the event period. This happens in the segment of code which can be found in Appendix A.

In this segment of code, the date terms are established so that the nonevent and event periods can be defined later. The pivot date is defined as the announcement date minus the event period. The event period can be changed via an input form at a website that will automatically run the analysis with the new parameters. In the case of this analysis, the event period was defined as 10 trading days prior to the announcement date. Last date is defined next and is equivalent to the *last announcement date of the company* plus a "cooldown" period which accounts for increased trading activity following an earnings announcement. This period was set at 5 trading days for the purpose of this study, but, as was the case with event period, it can easily be changed via an input form to run different analyses.

Next, the nonevent and event periods are finally created. Nonevent data (or control data) is defined as the range of dates between the last date and one day before the pivot date – this prevents the pivot date from being counted in both the nonevent and event periods. The end date is defined as one day before the announcement date, and the event data is defined as the range of days between the pivot date and the end date.

4.3 Data Analysis

The data was organized into a Django database that was defined by five major fields: company name, date, put volume, call volume, and percent earnings surprise. Once in this database, the data could be manipulated with relative ease. The flexibility of this database allowed for a multitude of methodologies to be applied to the data. Several different methods were used to examine the data and to look for relationships between option volumes and earnings surprise figures.

The first method used to test the data was the chi squared test of significance. For the chi squared test, an event period and a nonevent, or control period, had to be defined for *each announcement period*. This equated to four periods per year for each company, or 16 periods of interest for each company, equating to 1600 total periods for analysis across the entire database. Each period was divided into the nonevent (control) period and the event period. The nonevent period was defined as those days in which "normal" trading would occur – trading unaffected by the potential for inside information about earnings numbers. The event period marked that period of trading days leading up to an announcement that was likely to include trading activity by privileged investors who had been informed of the company's intended earnings report. The event period and nonevent period were assigned based on an expectation about when information reaches a market in the days prior to an announcement, but they could easily be changed in different runs of the analysis program to look at different relationships. For most analyses, the event period was defined as the 10 calendar days *preceding* the announcement. The nonevent period was the rest of the period starting from 5 days *after* the previous announcement (to account for increased trading activity immediately following an earnings announcement).

The chi squared test provided results from which it was difficult to draw much meaning. The chi squared test is as follows:

$$X^2 = \sum_{i=1}^{n} \frac{(x_i - x)^2}{x}$$

Where x_i corresponds to the observed call or put volume for a particular day in the event period, x = the expected value which was the mean call or put volume for the control or nonevent period, and n is the length of the event period in days.

Because option volumes can be very volatile, especially in the days leading up to an announcement, and because option volumes are often lifted in the thousands, tens of thousands, or hundreds of thousands of contracts daily, the difference between the observed value on an event period day and the expected value, or control period value, can often be very large. When this value is then subsequently squared as per the chi squared formula and divided by the relatively small control average, we see a huge number. Chi squared values are checked against critical values for different levels of significance. For a 95% confidence interval, we checked our chi squared values against a value of 18.307. Obviously, since the chi squared formula resulted in values in the thousands or tens of thousands, every company returned a result that rejected the null hypothesis, indicating that all the variances in options volumes leading up to announcements were unexplainable by pure statistical anomaly. Below is a chart that shows relevant averaged chi squared statistics for all companies for each quarter examined:

	Event Call Volume	Event Put Volume	Control Call Volume	Control Put Volume	Put Chi Squared Value	Call Chi Squared Value
Q1 2008	18805.64646	15025.86869	14384.9899	11578.64646	110727.267	219928.11
Q2 2008	20504.34343	17519.18182	15264.53535	11374.13131	137590.717	134520.53
Q3 2008	22477.42424	21376.70707	17716.17172	14797.22222	149520.281	85153.572
Q4 2008	23770.56566	19836.10101	17494.27273	14300.11111	101279.272	82795.386
Q1 2009	26508.87879	17386.62626	24125.40404	17908.9596	53901.2971	592129.61
Q2 2009	25094.84848	16656.09091	21038.48485	14010.92929	57306.0979	349017.82
Q3 2009	25597.87879	15119.69697	21271.24242	13675.53535	62056.964	413320.01
Q4 2009	27483.80808	15789.55556	24430.38384	12839.77778	57443.48	532258.58
Q1 2010	24606.05051	13958.31313	22002.90909	12353.40404	81350.5169	1291885.8
Q2 2010	28047.80808	17456.44444	20660.86869	13679.79798	200628.31	1200405.7
Q3 2010	35230.70707	16599.91919	25134.42424	12628.41414	82919.2572	6570551.3
Q4 2010	30053.62626	15069.27273	26262.47475	12412.36364	66775.0684	3157518.1
Q1 2011	24800.36364	15488.33333	24966.66667	14496.49495	70710.6634	1016795.1
Q2 2011	27996.41414	17814.75758	24534.86869	16088.51515	56926.6916	3229593.5
Q3 2011	27689.72727	17932.75758	23927.63636	17257.07071	49984.8104	1457809
Q4 2011	31763.48485	15834.07071	29204	13930.21212	65023.7463	9149603.6
Q1 2012	28542.80808	17684.46465	29077.47475	14887.59596	61190.9446	1191175.9
Q2 2012	21877.37755	13692.55102	22464.7449	13883.42857	76577.3638	4616062.5
Q3 2012	19311.48421	11738.78947	23751.57895	12274.65263	49097.3576	5766884.2
Q4 2012	41.74418605	16.87209302	16069.36047	9347.674419	407.025501	1246.9488

It should be not that the Q4 2012 data is incomplete because most companies had not yet reported for this quarter at the time the data was gathered. Because of this, these numbers are not representative of the entire dataset. Because the chi square values for our figures were so far beyond the critical values, and because all the values resulted in rejecting the null hypothesis, we decided to apply other measures to examine our data.

The next measure we used was a simple percentage deviation approach that in some ways mirrors the chi squared formula. This analysis was drawn from Heidle and Li (2005) and consists of computing a raw deviation and a percentage deviation. The raw deviation is simply the difference between the observed value and the control value (nonevent period mean). The percentage deviation is the raw deviation divided by the control value and then multiplied by 100 to put the figure in percentage terms. This measure provided more reasonable and meaningful results regarding the behavior of options volumes approaching announcement dates.

$$Raw\ Deviation = x_i - x$$

$$Percentage\ Deviation = \frac{x_i - x}{x} * 100$$

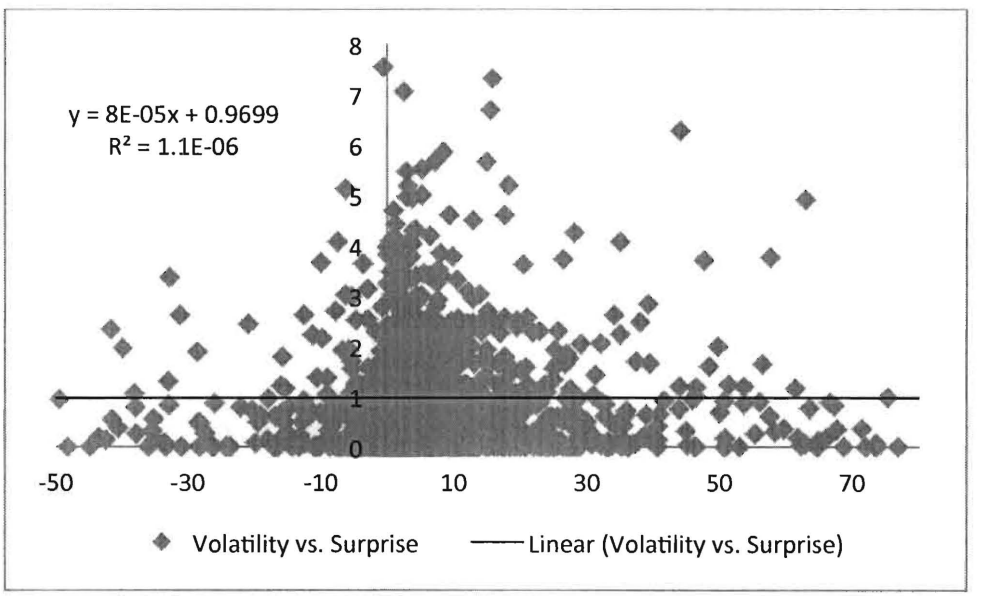
To conduct this analysis, we first computed a "master average" of the percentage deviation across all companies across all announcement periods for each of the 10 days of the event period. This resulted in the following table that shows, for each day leading up to an announcement (with Day 0 being the announcement day and Day -9 being 10 trading days prior), the expected percentage deviation from the mean of call or put option volumes.

Event Day -9	Event Day -8	Event Day -7	Event Day -6	Event Day -5	Event Day -4	Event Day -3	Event Day -2	Event Day -1	Event Day 0
-6.8672%	11.4433%	24.0738%	67.5439%	69.0890%	9.9405%	18.4363%	22.2095%	90.0966%	224.5402%
1.9834%	-0.2491%	2.5724%	6.1372%	7.9256%	12.2351%	19.9599%	29.2652%	99.3658%	179.7559%

Again, each one of these figures represents the *expected deviation from the control mean* of a company's call or put option value during any of the ten trading days leading up to an announcement. Once we had this data, we were now able to look company-by-company to see where there was particular evidence in the option trading volume for a company that some sort of abnormal trading was occurring. We then compared the abnormal deviations for those companies to their respective earnings surprise for the period to see if there was a correlation between abnormality of the deviation in volume to the size and direction of a firm's earnings surprise figure.

According to Pan and Poteshman's 2006 paper, "Applying the same predictive analysis [as that applied to the stock option market] to the index option market, however, yielded no evidence of informed trading. This is indeed consistent with the view that informed traders tend to possess firm-specific rather than market-wide information." Likewise, we would expect these average deviations reported above to be "normal" across the entire S&P index for which we have calculated them – that is to say that by taking the aggregate average we have corrected for nonpublic information and abnormal option volumes to arrive at a standardized deviation from the control mean. When we compare this figure to individual firms, then, we should expect to find firms for which daily volume greatly deviates from this "normal" deviation, and it is in those firms that we will find the best evidence for trading on non-public information.

Finally, we conducted a rough volatility measure for each company for each announcement period to be compared against earnings surprise for the same period. The volatility measure was calculated by simply taking finding the absolute value of the difference between the observed value on a particular event day and the control value for the period as a whole and then multiplying that difference by a factor to account for the "distance" of the event day from the announcement date. We then took the sum of each of these calculations to arrive at one figure that roughly represents the volatility of options volume in the lead-up to an announcement. We expected to see more volatility when earnings surprises were greater. The results of this analysis can be seen in the following graph.



As one can see, the distribution of these data points does not point toward a positive correlation between surprise figures (on the x-axis) and an increase in our volatility measure (as displayed on the y-axis). One can see by the flat trend line that there is no statistical correlation between the two figures. One can conclude, then, that variability in option volume trading leading up to an announcement is not a good or reliable predictor of earnings surprise.

There are many ways to account for this. It is probably most likely that, even if a market participant has knowledge of the earnings figures before they are announced, their trading activity would tend to be statistically insignificant amidst the volume of speculative trades made leading up to an earnings announcement. Likewise, a well-educated investor who can accurately predict the earnings announcement may take a position in options leading up to the announcement – their activity, too, will be "drowned out" by the activity of speculators or less-savvy investors.

5. Results and Analysis

The initial analysis performed, as indicated earlier, was the chi squared analysis. Using a critical value of 18.307 to correspond to a confidence interval of 95% with 10 degrees of freedom, the chi squared analysis easily confirmed the hypothesis that trading volume increases in the days leading up to an announcement. In fact, for every company for every period for which data was available, the chi squared analysis gave strong statistical evidence in support of the hypothesis.

The chi squared analysis resulted in huge chi square values for both put and call options. As discussed in some detail earlier, this was a result of the nature of the option volumes and the formula, but also as a result of the behavior of the markets. As major information-dissemination events approach, such as earnings announcements, trading activity tends to increase as market participants try to forecast this information and the effect it will have on the market. These participants, consequently, take larger positions and trade in and out of those positions as they get more information all the way up until the trading date, leading to an increase in the volume of options traded. Because the chi squared analysis confirmed this result, it was necessary to look further into the data to determine how the markets were behaving before announcements.

Heidle and Li's method was used to examine the behavior of options volumes in the lead-up to announcement dates. As noted previously, using this method we arrived at a table of 10 master

averages that describe, based on our sample of 100 companies, how one would expect option volume to behave on each of the 10 trading days leading up to an announcement. Each percentage describes how much that event day's actual volume should differ from that period's control, or nonevent, average volume. The table is reprinted below for reference:

Event Day -9	Event Day -8	Event Day -7	Event Day -6	Event Day -5	Event Day -4	Event Day -3	Event Day -2	Event Day -1	Event Day 0
-6.8672%	11.4433%	24.0738%	67.5439%	69.0890%	9.9405%	18.4363%	22.2095%	90.0966%	224.5402%
1.9834%	-0.2491%	2.5724%	6.1372%	7.9256%	12.2351%	19.9599%	29.2652%	99.3658%	179.7559%

Each company, then, had its own figures for each day for each period, and each period had associated with it a particular earnings surprise. With this data, we could determine how option volume behaves for an earnings miss or a beat relative to expected volume. In Appendix B, one can find a table with each company's average deviations from the control mean for the 10 trading days leading up to an earnings announcement.

It is quite easy to see, from this table, a trend that dominates throughout: they final days of the event period are generally marked by a huge increase in volume, especially on the day of the announcement. So, on average, we can see how each company's average volumes compared to the entire index's volumes over the period observed, but how predictive are abnormal volumes for a particular event period? This is the problem we examined next.

To examine the correlation between options volumes and surprises, we needed a number that could represent an entire 10-day event period for a firm that could be compared against the earnings surprise figure. To do this, a proportion was calculated for each earnings period for each company. The earnings

proportion was calculated by taking the sum of the proportion of event day volume to control period volume for each period for each company. This number was then divided by the same aggregate proportion figure for all companies surveyed. The end result was a proportion that represented the volume behavior of the options market for that company for that particular period; more specifically, if this figure was 1, it indicated that the volume activity for that period was exactly equal to the volume activity one would expect for the average company in the dataset, if the figure was more than 1, then greater volume than expected had occurred, and if it was less than 1, then less volume than expected had occurred. Extrapolating, for call volumes, one would expect values greater than 1 for earnings surprises greater than 0%, values of exactly 1 for earnings surprises of 0%, and values of less than 1 for earnings surprises of less than 0%. One would expect the opposite for put volumes: values of less than 1 for earnings surprises of greater than 0%, values of exactly 1 for earnings surprises of 0%, and values of greater than 1 for earnings surprises of less than 0%.

For each company, a success rate was calculated based upon the accuracy with which the firm's volume proportion measurement for either calls or puts could predict the direction of earnings. The rate was calculated by simply dividing the number of periods for which the criteria were met (i.e. positive earnings with a call proportion greater than 1, negative earnings with a call proportion less than 1, negative earnings with a put proportion greater than 1, positive earnings with a put proportion less than 1, or flat earnings with call and put proportions of 1) by the number of periods examined. For each company, a call success rate, a put success rate, and a combined success rate were calculated.

The table in Appendix C show, for each company, the success rate for calls, puts, and the combined values for predicting the direction of earnings.

As one can see, on average, the call and combined method actually work less well for predicting earnings than simply guessing, with both methods coming in at well below 50% accuracy. The put method, however, predicted the direction of earnings correctly 62.08% of the time on average across all 100 companies. This is a significantly better than chance rate of success and an investor could potentially use this method to predict the direction of earnings before they are released and take a profitable position ahead of the marketplace.

The call method was most successful for ABT, for which company it predicted the correct direction of earnings surprise 78.95% of the time. The put method was most effective for SPG, for which it predicted the proper direction of earnings 94.74% of the time. Finally, the combined method was most effective for WMT, for which it predicted the direction of an earnings surprise 61.11% of the time.

6. Conclusion

Information is, as has been stated, critical to the efficient functioning of any market. In the stock and options markets, information can appear in many forms, and those with the requisite tools and knowledge can mine this information before other market participants and use this information to achieve abnormal returns. This process of information discovery sets effective and successful investors apart from the losing investors. This study aimed to determine if information leakage occurred in stock options markets and if information from stock options markets, particularly from volumes, could be used to predict earnings.

The results of this study indicate that important market information does leak in the stock options market. Whether this information is proprietary information only available to some privileged investors or information that has arisen as the result of superior investment knowledge and forecasting ability is uncertain. What has been shown, however, is that examining the deviation of put contract volume from the norm with respect to the average expect put contract deviation can provide a signal to

an investor that will allow him or her to make a better-than-chance forecast as to the direction of an earnings surprise. This finding is in line with those of Jin et al. who concluded that "the predictive ability of the option measures increases in the days immediately prior to the information events, suggesting superior information discovery," indicating that option volumes can predict earnings announcements as better information has been priced into the markets at these late dates in an announcement period (Jin, Livnat, & Zhang, 2011).

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Appendix A - Code

Code Responsible for Defining Data Parameters

```
for announcementDate in announcementDates:


                if not lastDate:
                    lastDate = announcementDate.date
                    continue
                pivotDate = announcementDate.date - timedelta( days =
analysisRun.eventPeriod )
                lastDate = lastDate + timedelta( days =
analysisRun.cooldownPeriod )
                #to do determine how date queries work - inclusive or
exclusive
                nonEventData = HistoricalCompanyVolume.objects.filter(
company = company ).filter( date__range = [ lastDate, pivotDate -
timedelta( days = 1 ) ] )
                endDate = announcementDate.date - timedelta( days = 1 )
                #eventData = HistoricalCompanyVolume.objects.filter(
company = company ).filter( date__range = [ pivotDate,
announcementDate ] )
                eventData = HistoricalCompanyVolume.objects.filter(
company = company ).filter( date__range = [ pivotDate, endDate ] )
```

Appendix B

As stated in the body of this document, the following table contains data for each company about the average deviation from the control period for each event day's option volume. Event Days -9 through 0 (with Day 0 being the announcement day) are listed, and for each day an aggregate average deviation is given for the firm. This aggregate average is calculated as the firm's average deviation for that day across all recorded periods divided by the control period average across all recorded periods.

Appendix C – Predictive Success Rates

Company	Call Success Rate	Put Success Rate	Combined Success Rate
AAPL	26.32%	84.21%	10.53%
ABT	78.95%	47.37%	36.84%
ACN	55.56%	33.33%	33.33%
AEP	36.84%	63.16%	21.05%
ALL	43.75%	62.50%	31.25%
AMGN	36.84%	68.42%	15.79%
AMZN	63.16%	52.63%	15.79%
APA	61.11%	55.56%	16.67%
APC	26.32%	78.95%	5.26%
AXP	26.32%	73.68%	10.53%
BA	31.58%	57.89%	10.53%
BAC	52.94%	47.06%	11.76%
BAX	57.89%	42.11%	10.53%
BHI	52.63%	52.63%	26.32%
BK	36.84%	52.63%	31.58%
BMY	26.32%	68.42%	5.26%
C	44.44%	61.11%	16.67%
CAT	73.68%	63.16%	36.84%
CL	78.95%	78.95%	57.89%
CMCSA	31.58%	52.63%	57.89%
COF	22.22%	66.67%	22.22%
COP	57.89%	63.16%	31.58%
COST	58.82%	41.18%	58.82%
CSCO	55.56%	50.00%	38.89%
CVS	44.44%	61.11%	27.78%
CVX	27.78%	66.67%	5.56%
DD	21.05%	68.42%	42.11%
DELL	50.00%	33.33%	27.78%
DIS	55.56%	61.11%	27.78%
DOW	50.00%	56.25%	31.25%
DVN	27.78%	66.67%	5.56%
EBAY	68.42%	52.63%	21.05%
EMC	47.37%	63.16%	31.58%
EMR	50.00%	61.11%	22.22%
EXC	50.00%	61.11%	33.33%
F	37.50%	75.00%	12.50%
FCX	47.37%	89.47%	36.84%
FDX	38.89%	33.33%	27.78%
GD	21.05%	78.95%	42.11%
GE	15.79%	68.42%	26.32%

GILD	31.58%	73.68%	26.32%
GOOG	52.63%	63.16%	26.32%
GS	63.16%	52.63%	15.79%
HAL	36.84%	78.95%	36.84%
HD	22.22%	55.56%	33.33%
HNZ	22.22%	66.67%	33.33%
HON	21.05%	57.89%	21.05%
HPQ	52.94%	29.41%	41.18%
IBM	26.32%	68.42%	15.79%
INTC	22.22%	61.11%	38.89%
JNJ	15.79%	78.95%	26.32%
JPM	47.06%	76.47%	35.29%
KO	17.65%	70.59%	11.76%
LLY	41.18%	70.59%	11.76%
LMT	35.29%	58.82%	29.41%
LOW	41.18%	47.06%	47.06%
MA	29.41%	94.12%	23.53%
MCD	11.76%	76.47%	23.53%
MDT	41.18%	41.18%	17.65%
MDLZ	29.41%	64.71%	29.41%
MET	23.53%	82.35%	5.88%
MMM	41.18%	58.82%	23.53%
MO	23.53%	58.82%	17.65%
MON	46.67%	80.00%	40.00%
MRK	17.65%	76.47%	17.65%
MS	76.47%	29.41%	5.88%
MSFT	35.29%	58.82%	29.41%
NKE	58.82%	29.41%	23.53%
NOV	37.50%	62.50%	12.50%
NSC	35.29%	58.82%	17.65%
NWSA	52.94%	58.82%	23.53%
ORCL	52.94%	58.82%	23.53%
OXY	23.53%	58.82%	17.65%
PEP	21.05%	73.68%	26.32%
PFE	44.44%	55.56%	44.44%
PG	68.42%	52.63%	42.11%
PM	22.22%	72.22%	16.67%
QCOM	44.44%	50.00%	16.67%
RTN	10.53%	89.47%	10.53%
SBUX	66.67%	50.00%	38.89%
SLB	36.84%	52.63%	31.58%
SO	66.67%	38.89%	16.67%
SPG	5.26%	94.74%	10.53%

T	26.32%	78.95%	26.32%
TGT	50.00%	66.67%	27.78%
TWX	44.44%	55.56%	33.33%
TXN	72.22%	44.44%	27.78%
UNH	31.58%	89.47%	21.05%
UNP	31.58%	84.21%	26.32%
UPS	31.58%	63.16%	26.32%
USB	10.53%	73.68%	26.32%
UTX	5.26%	63.16%	31.58%
V	12.50%	93.75%	6.25%
WAG	38.89%	44.44%	27.78%
WFC	31.58%	78.95%	21.05%
WMB	33.33%	44.44%	44.44%
WMT	61.11%	66.67%	61.11%
VZ	31.58%	63.16%	26.32%
XOM	61.11%	33.33%	5.56%
AVG	**39.76%**	**62.08%**	**25.58%**

Company	Type	Day -9	Day -8	Day -7	Day -6	Day -5	Day -4	Day -3	Day -2	Day -1	Day 0
S&P 100	Call	-6.867%	11.443%	24.074%	67.544%	69.089%	9.940%	18.436%	22.209%	90.097%	224.540%
S&P100	Put	1.983%	-0.249%	2.572%	6.137%	7.926%	12.235%	19.960%	29.265%	99.366%	179.756%
AAPL	Call	3.395%	0.188%	1.010%	-2.181%	6.853%	13.610%	22.735%	38.784%	34.289%	89.876%
AAPL	Put	2.783%	-6.252%	2.883%	-7.723%	-1.259%	3.721%	13.663%	26.223%	18.701%	76.675%
ABT	Call	4.472%	8.647%	250.783%	3640.183%	1409.503%	101.642%	26.078%	209.461%	85.561%	141.340%
ABT	Put	4.053%	-8.434%	12.067%	56.416%	30.220%	13.877%	22.693%	51.465%	153.074%	188.031%
ACN	Call	-0.565%	-15.617%	-8.480%	-17.001%	117.356%	32.092%	69.350%	33.403%	117.357%	325.650%
ACN	Put	-21.165%	10.228%	14.751%	3.234%	36.496%	155.024%	114.549%	66.370%	134.246%	435.497%
AEP	Call	-42.869%	-25.299%	-22.826%	-21.200%	-59.375%	-18.581%	-54.385%	-56.914%	17.506%	-17.409%
AEP	Put	-33.544%	-10.552%	12.476%	58.110%	8.568%	1.707%	-26.126%	-16.423%	35.964%	55.857%
ALL	Call	26.101%	33.250%	-39.593%	-28.983%	-32.608%	-52.386%	39.766%	-15.424%	8.114%	249.597%
ALL	Put	-14.300%	2.975%	-2.552%	7.942%	4.118%	0.173%	42.334%	-0.212%	79.373%	258.961%
AMGN	Call	21.025%	7.229%	26.433%	5.797%	3.279%	49.387%	23.047%	14.057%	9.371%	99.285%
AMGN	Put	11.501%	-6.305%	-1.871%	-2.057%	31.565%	53.170%	0.680%	13.539%	11.441%	119.193%
AMZN	Call	1.302%	4.591%	-3.760%	12.167%	22.899%	20.047%	14.050%	-8.276%	15.764%	239.283%
AMZN	Put	-1.724%	7.325%	7.031%	2.975%	16.344%	16.560%	5.041%	-20.427%	5.175%	192.807%
APA	Call	61.405%	-0.831%	-28.902%	-19.546%	-13.238%	-2.943%	9.382%	14.719%	56.383%	86.303%
APA	Put	39.101%	3.326%	-12.080%	-17.053%	-19.565%	-7.523%	-23.581%	1.148%	38.624%	80.387%
APC	Call	-8.000%	-13.309%	19.530%	-12.416%	-22.418%	-12.822%	-19.844%	-3.005%	-8.626%	65.004%
APC	Put	-13.487%	-23.260%	-14.214%	-8.656%	-22.391%	-24.166%	-11.448%	13.973%	11.651%	67.408%
AXP	Call	-7.974%	-2.819%	-9.256%	19.615%	18.560%	9.458%	-13.487%	6.724%	5.521%	98.256%
AXP	Put	-5.401%	-7.194%	2.857%	25.655%	2.015%	21.081%	21.272%	-3.449%	15.670%	129.733%
BA	Call	-32.312%	-19.272%	-28.377%	-11.371%	-17.238%	-13.350%	-23.490%	-12.948%	31.367%	81.013%
BA	Put	-4.830%	-11.191%	0.230%	3.492%	-15.074%	0.332%	-16.648%	13.371%	82.502%	120.138%
BAC	Call	-0.267%	-8.259%	7.859%	14.280%	8.314%	18.285%	32.387%	65.143%	102.424%	121.473%
BAC	Put	-9.236%	-18.099%	7.187%	11.155%	5.865%	2.758%	53.007%	47.022%	80.177%	126.967%
BAX	Call	23.408%	9.976%	69.141%	67.253%	13.090%	-6.789%	49.243%	38.238%	84.743%	262.912%
BAX	Put	43.595%	26.566%	-8.485%	147.474%	24.796%	14.816%	94.799%	41.715%	138.345%	270.990%
BHI	Call	-3.360%	8.460%	2.539%	-3.682%	8.100%	-1.370%	21.496%	63.605%	183.825%	315.975%

BHI	Put	3.654%	-10.183%	40.848%	-3.839%	34.433%	14.711%	24.154%	112.594%	191.233%	291.934%
BK	Call	52.762%	17.386%	-36.697%	-6.153%	14.335%	24.131%	33.555%	28.624%	78.943%	139.607%
BK	Put	22.767%	12.391%	-22.494%	5.805%	-13.449%	-35.290%	26.400%	60.817%	98.524%	205.441%
BMY	Call	-45.562%	-52.278%	-55.563%	-50.886%	-22.326%	-31.945%	-37.597%	-41.333%	-22.741%	1.663%
BMY	Put	-22.026%	-30.703%	-27.857%	4.465%	19.498%	-5.703%	-12.615%	-1.125%	56.160%	34.476%
C	Call	3.616%	-5.789%	15.607%	-4.690%	-20.975%	30.593%	60.803%	46.954%	86.622%	119.424%
C	Put	-12.196%	-18.105%	5.517%	-10.920%	-9.462%	23.511%	33.501%	36.265%	93.561%	103.004%
CAT	Call	1.207%	351.289%	317.404%	-11.406%	147.242%	357.953%	163.231%	-5.701%	408.718%	177.613%
CAT	Put	-1.228%	-7.719%	28.259%	-6.426%	28.353%	7.126%	9.539%	39.053%	122.968%	179.580%
CL	Call	-4.135%	16.152%	177.491%	2244.572%	4893.097%	27.244%	23.368%	-0.861%	94.035%	223.517%
CL	Put	-0.676%	4.647%	-5.762%	12.307%	56.623%	5.153%	28.392%	19.200%	141.321%	250.150%
CMCSA	Call	-9.594%	13.606%	-19.330%	-10.986%	15.401%	-10.689%	-12.534%	4.376%	165.250%	142.373%
CMCSA	Put	31.838%	-27.051%	0.593%	35.014%	5.411%	-5.009%	35.768%	17.889%	225.156%	209.141%
COF	Call	-26.743%	-24.250%	-3.133%	35.756%	-0.077%	1.570%	-12.160%	28.855%	30.498%	140.761%
COF	Put	-11.310%	-13.701%	9.299%	3.378%	44.416%	17.773%	-19.400%	26.113%	50.698%	174.648%
COP	Call	-12.923%	-14.722%	-11.064%	-2.195%	206.466%	6.401%	18.737%	-4.597%	1184.744%	99.947%
COP	Put	32.189%	7.696%	20.512%	15.677%	3.686%	5.381%	21.505%	21.978%	105.393%	97.163%
COST	Call	-25.160%	-29.716%	19.905%	2.506%	1.468%	28.736%	-2.161%	54.732%	174.238%	218.440%
COST	Put	-4.173%	39.979%	-30.159%	77.249%	17.378%	25.976%	0.696%	73.998%	203.976%	229.013%
CSCO	Call	1.264%	12.088%	1.149%	10.640%	1.153%	28.093%	43.267%	68.959%	107.044%	346.443%
CSCO	Put	2.801%	-4.608%	-2.482%	-1.400%	3.609%	15.247%	46.996%	86.344%	98.875%	363.398%
CVS	Call	-29.125%	-39.431%	-2.571%	-17.144%	6.439%	5.208%	15.569%	-4.376%	70.266%	314.259%
CVS	Put	-28.818%	-6.919%	-17.008%	-4.358%	37.229%	-3.742%	-11.931%	46.414%	130.577%	299.524%
CVX	Call	-18.042%	-22.646%	-31.608%	-12.195%	-25.987%	-39.184%	-20.904%	-27.068%	4.086%	-10.594%
CVX	Put	-0.580%	-5.895%	-10.895%	-3.491%	3.605%	-18.266%	6.241%	8.729%	52.390%	33.780%
DD	Call	-27.917%	-37.536%	-23.456%	-30.293%	-22.535%	-13.771%	-6.962%	22.156%	90.549%	75.482%
DD	Put	18.191%	17.757%	-8.644%	-7.876%	0.279%	3.737%	22.820%	49.921%	133.295%	129.204%
DELL	Call	6.892%	36.514%	16.078%	10.578%	19.185%	29.193%	58.096%	26.279%	125.920%	426.929%
DELL	Put	-4.679%	52.043%	24.500%	4.828%	34.080%	44.424%	41.506%	92.297%	224.930%	577.884%
DIS	Call	-26.162%	-9.854%	-6.287%	8.579%	26.551%	-0.480%	1.405%	-0.205%	60.100%	324.811%

DIS	Put	-19.268%	-18.000%	-8.928%	18.659%	24.250%	-2.771%	42.348%	45.836%	63.696%	419.983%
DOW	Call	-6.450%	-29.560%	-8.905%	10.400%	52.594%	32.667%	25.859%	-8.325%	65.380%	141.213%
DOW	Put	25.514%	14.050%	26.194%	-23.463%	13.629%	12.102%	21.671%	18.761%	69.586%	158.048%
DVN	Call	-13.902%	14.020%	-20.036%	0.352%	-26.950%	-25.477%	-20.663%	-6.076%	52.613%	126.513%
DVN	Put	-15.536%	-6.046%	-31.881%	-10.643%	-18.134%	-25.879%	-31.956%	-13.647%	52.492%	128.529%
EBAY	Call	22.315%	1.449%	-3.059%	12.786%	11.878%	71.189%	21.396%	54.067%	84.206%	430.134%
EBAY	Put	2.813%	-18.514%	-12.065%	22.214%	7.563%	66.305%	20.085%	50.424%	85.290%	353.089%
EMC	Call	23.889%	9.789%	26.046%	34.759%	34.058%	45.155%	80.629%	63.611%	116.811%	137.416%
EMC	Put	49.089%	-2.650%	-5.808%	9.358%	0.215%	38.982%	21.686%	14.610%	128.381%	140.790%
EMR	Call	-9.069%	-15.127%	-20.899%	-32.340%	-24.321%	-9.780%	30.533%	4.651%	84.485%	155.490%
EMR	Put	-4.344%	11.291%	-6.760%	-17.067%	-9.363%	30.511%	28.916%	40.993%	158.332%	207.052%
EXC	Call	5.328%	-9.642%	-26.133%	29.544%	17.755%	20.444%	139.018%	7.111%	11.938%	23.568%
EXC	Put	0.217%	12.263%	14.264%	80.111%	50.435%	60.643%	4.506%	28.052%	60.639%	111.273%
F	Call	4.224%	14.649%	-8.491%	3.531%	12.378%	-13.048%	-5.204%	22.247%	96.849%	176.611%
F	Put	0.552%	-9.580%	-5.326%	2.606%	6.749%	9.528%	18.152%	11.296%	131.771%	138.887%
FCX	Call	37.868%	17.281%	268.109%	394.963%	3.480%	-3.820%	-8.636%	7.514%	37.420%	52.430%
FCX	Put	-2.723%	-11.977%	0.430%	17.186%	12.226%	2.887%	6.659%	3.571%	43.727%	59.759%
FDX	Call	22.393%	19.887%	58.142%	43.247%	26.149%	70.830%	98.114%	86.914%	295.472%	334.203%
FDX	Put	19.746%	49.012%	49.390%	13.160%	30.644%	41.151%	79.502%	97.404%	258.105%	369.145%
GD	Call	-41.688%	9.702%	-17.746%	420.872%	-3.291%	-0.747%	4.540%	0.587%	74.019%	127.583%
GD	Put	-17.738%	-13.793%	8.827%	-8.347%	-32.033%	-26.701%	63.691%	38.977%	124.707%	100.585%
GE	Call	-35.170%	-26.174%	-16.554%	-25.563%	-28.189%	-9.951%	-0.480%	5.421%	56.258%	123.379%
GE	Put	-14.249%	-1.351%	16.440%	7.350%	-27.197%	-3.353%	24.800%	32.498%	118.408%	168.959%
GILD	Call	-30.787%	-4.095%	-22.693%	43.191%	33.134%	25.514%	8.945%	29.545%	-3.398%	121.849%
GILD	Put	-5.380%	-26.171%	-23.767%	19.217%	50.157%	36.046%	10.168%	58.377%	60.661%	160.319%
GOOG	Call	13.272%	5.198%	13.895%	17.328%	15.502%	19.358%	30.344%	25.717%	48.476%	237.096%
GOOG	Put	10.180%	-1.912%	3.542%	11.212%	3.880%	17.910%	24.268%	20.539%	27.961%	212.714%
GS	Call	-9.154%	-5.300%	-4.101%	-17.724%	5.330%	16.738%	30.497%	67.096%	136.346%	200.528%
GS	Put	-26.905%	-11.033%	-6.531%	-17.836%	-0.297%	3.594%	17.778%	57.928%	109.273%	174.914%
HAL	Call	2.019%	8.801%	18.649%	10.739%	5.861%	23.291%	34.009%	72.029%	133.708%	158.114%

HAL	Put	-6.882%	14.737%	9.345%	-3.570%	24.087%	78.534%	0.777%	34.716%	100.803%	131.865%
HD	Call	-27.522%	-23.951%	-0.938%	11.781%	3.539%	4.699%	18.495%	25.401%	156.370%	145.349%
HD	Put	-12.476%	19.727%	0.877%	29.496%	8.055%	18.766%	34.399%	61.820%	222.798%	140.218%
HNZ	Call	4.078%	-11.051%	7.606%	-45.652%	-22.952%	-21.117%	114.125%	38.241%	95.057%	98.251%
HNZ	Put	65.668%	-10.618%	-11.406%	14.065%	43.239%	-39.752%	85.107%	70.738%	165.760%	201.025%
HON	Call	-17.833%	-33.852%	-26.685%	-25.737%	-17.945%	-33.947%	-25.972%	0.115%	73.277%	115.993%
HON	Put	-26.330%	5.516%	-13.268%	-6.678%	29.501%	16.962%	-5.527%	16.156%	147.867%	174.856%
HPQ	Call	-6.776%	127.498%	53.937%	81.213%	183.884%	107.647%	64.430%	82.979%	121.513%	370.059%
HPQ	Put	-0.942%	128.643%	60.080%	45.292%	128.859%	44.013%	43.954%	62.189%	156.771%	462.504%
IBM	Call	-5.917%	9.078%	-11.581%	-4.854%	4.757%	22.048%	41.504%	16.694%	81.589%	250.514%
IBM	Put	8.835%	1.251%	-0.736%	3.412%	5.671%	34.351%	25.051%	21.625%	56.124%	244.072%
INTC	Call	-41.871%	-26.569%	-22.422%	-24.295%	-1.406%	-5.643%	8.336%	-1.527%	66.956%	262.225%
INTC	Put	-21.164%	-1.815%	31.773%	11.066%	19.644%	23.223%	30.374%	40.296%	68.188%	382.977%
JNJ	Call	-27.159%	-51.068%	-47.211%	-37.586%	-21.745%	-24.832%	-43.077%	27.071%	31.574%	71.967%
JNJ	Put	-22.092%	-32.357%	-18.880%	-4.537%	-3.661%	10.844%	12.973%	55.052%	133.099%	84.452%
JPM	Call	30.132%	255.497%	-4.359%	0.617%	11.814%	16.536%	15.282%	35.522%	133.524%	152.921%
JPM	Put	0.566%	-0.101%	26.329%	3.862%	17.569%	4.589%	11.111%	52.168%	85.578%	119.434%
KO	Call	-33.797%	-32.091%	-48.814%	-55.012%	-25.239%	-39.418%	-34.981%	-16.124%	37.985%	67.740%
KO	Put	33.860%	-14.329%	-5.359%	-21.640%	-11.235%	-7.435%	54.404%	2.918%	113.322%	133.735%
LLY	Call	-26.593%	9.354%	29.334%	-4.146%	-20.641%	-11.741%	15.461%	2.646%	59.908%	74.723%
LLY	Put	-12.217%	-4.905%	17.655%	14.836%	-16.554%	20.040%	-10.981%	15.851%	133.106%	152.351%
LMT	Call	-21.797%	-51.032%	14.255%	4.510%	-32.280%	-21.331%	31.918%	-29.866%	75.102%	47.000%
LMT	Put	-22.653%	4.685%	33.499%	19.692%	-5.815%	-29.963%	34.976%	22.727%	124.897%	113.510%
LOW	Call	3.773%	26.995%	-17.310%	-18.260%	8.243%	40.585%	51.975%	63.316%	133.361%	160.047%
LOW	Put	41.174%	25.936%	-29.053%	15.075%	8.136%	64.917%	96.163%	24.970%	305.133%	326.156%
MA	Call	-8.410%	-23.539%	-29.629%	-36.301%	-27.795%	-0.257%	-5.764%	-9.985%	111.412%	263.973%
MA	Put	3.950%	-23.698%	-40.119%	-39.089%	-33.025%	-15.014%	-29.748%	-19.023%	96.959%	211.386%
MCD	Call	-38.848%	-46.280%	-27.253%	-34.877%	-40.713%	-26.068%	-21.634%	-15.843%	29.273%	59.308%
MCD	Put	-1.081%	1.190%	4.506%	-2.981%	-3.260%	-2.577%	-15.647%	9.888%	152.343%	182.011%
MDT	Call	27.586%	-17.019%	-30.882%	7.318%	-12.623%	29.702%	14.075%	74.560%	200.435%	218.296%

MDT	Put	35.228%	-9.435%	55.129%	31.095%	26.658%	13.766%	23.800%	85.753%	254.723%	228.126%
MDLZ	Call	-27.877%	-32.199%	-43.604%	1.678%	-49.467%	-27.594%	-9.649%	-35.898%	49.037%	67.202%
MDLZ	Put	28.369%	13.705%	8.759%	28.617%	-25.533%	-5.322%	18.525%	-10.411%	85.607%	206.914%
MET	Call	-11.508%	-20.065%	-7.210%	-26.680%	-4.801%	4.383%	-27.255%	-36.699%	-7.975%	73.004%
MET	Put	7.281%	-5.945%	-21.452%	-24.812%	-16.449%	-9.059%	2.405%	-18.129%	10.802%	60.780%
MMM	Call	-17.260%	-15.016%	16.544%	16.466%	21.859%	18.183%	10.260%	11.706%	167.889%	198.540%
MMM	Put	-13.677%	-20.302%	21.690%	17.831%	3.237%	7.611%	11.484%	16.333%	163.014%	244.132%
MO	Call	-57.966%	-63.422%	-59.775%	-71.669%	-72.256%	-65.640%	-63.210%	-67.236%	-54.639%	-61.567%
MO	Put	-20.117%	-12.144%	-12.081%	-41.399%	-34.125%	-20.402%	-12.133%	-2.691%	40.423%	30.784%
MON	Call	-23.970%	-9.700%	0.143%	22.492%	-1.370%	4.726%	-0.285%	180.112%	363.584%	254.922%
MON	Put	0.171%	-22.721%	7.178%	31.612%	3.282%	8.097%	1.770%	35.926%	145.841%	240.287%
MRK	Call	-6.781%	-0.546%	-32.361%	-34.007%	-33.702%	-35.331%	-13.660%	-21.559%	23.413%	63.457%
MRK	Put	36.410%	18.338%	-3.864%	4.830%	-23.466%	-18.684%	70.129%	16.766%	85.547%	75.361%
MS	Call	8.507%	-17.876%	38.308%	21.680%	16.589%	31.410%	55.252%	21.884%	118.202%	179.846%
MS	Put	-11.691%	11.096%	25.034%	-1.673%	37.654%	12.208%	76.784%	25.187%	115.542%	190.854%
MSFT	Call	28.807%	-4.755%	-6.465%	41.332%	-8.052%	16.569%	22.261%	28.159%	37.610%	233.083%
MSFT	Put	31.299%	3.924%	7.600%	16.777%	10.216%	18.564%	25.522%	59.779%	59.001%	270.683%
NKE	Call	12.872%	-18.676%	-2.625%	-9.866%	26.318%	50.687%	66.285%	68.717%	133.820%	481.802%
NKE	Put	15.267%	4.895%	-4.812%	-15.238%	52.508%	48.983%	30.367%	110.787%	159.157%	564.997%
NOV	Call	19.103%	-2.808%	2.866%	-3.589%	-5.289%	5.712%	-19.109%	16.441%	41.465%	204.726%
NOV	Put	10.308%	5.231%	26.695%	-17.072%	-20.615%	-6.534%	1.660%	-2.328%	65.920%	247.938%
NSC	Call	45.787%	-3.911%	-21.894%	-6.418%	2.663%	16.073%	0.200%	2.743%	0.229%	95.648%
NSC	Put	35.558%	-9.069%	-1.860%	-15.653%	7.977%	66.448%	-17.583%	-10.088%	-12.655%	129.837%
NWSA	Call	-44.046%	75.077%	2.043%	26.881%	55.463%	-12.796%	167.569%	9.503%	-17.038%	273.407%
NWSA	Put	-42.697%	29.277%	35.684%	68.483%	39.921%	-3.274%	134.869%	-8.984%	-34.833%	189.367%
ORCL	Call	-6.381%	2.401%	43.201%	16.589%	19.608%	17.054%	64.396%	78.603%	107.344%	385.095%
ORCL	Put	-5.438%	-0.316%	53.788%	25.937%	9.546%	48.067%	44.401%	47.156%	120.507%	358.749%
OXY	Call	-29.661%	-24.132%	-11.929%	-22.095%	-19.564%	-14.152%	-19.910%	-24.019%	-0.991%	45.017%
OXY	Put	21.722%	-4.539%	-12.490%	17.152%	-1.350%	8.301%	-14.551%	-14.266%	72.935%	117.439%
PEP	Call	-44.518%	-29.362%	-23.865%	5.465%	-42.750%	26.985%	9.392%	21.622%	95.172%	146.507%

PEP	Put	-10.048%	-17.618%	-5.033%	-0.609%	-7.106%	32.056%	57.722%	41.690%	150.174%	267.287%
PFE	Call	-19.891%	-3.081%	34.932%	-2.350%	13.440%	30.468%	-0.659%	-12.131%	195.904%	1320.864%
PFE	Put	-7.718%	12.448%	39.654%	-8.775%	27.859%	-1.055%	4.942%	2.296%	62.105%	167.679%
PG	Call	10.492%	1204.281%	1557.615%	532.719%	38.600%	11.597%	113.479%	471.957%	93.687%	127.537%
PG	Put	7.842%	-5.095%	-2.774%	-0.153%	24.015%	0.490%	44.931%	13.262%	125.568%	161.203%
PM	Call	-42.525%	-54.720%	-46.329%	-62.919%	-45.540%	-31.487%	-44.315%	-33.381%	-0.262%	17.432%
PM	Put	19.139%	-26.635%	4.623%	-20.191%	-2.765%	-13.412%	-12.778%	11.185%	61.422%	106.230%
QCOM	Call	-8.232%	4.661%	10.198%	4.186%	18.876%	43.223%	51.551%	12.193%	34.947%	252.605%
QCOM	Put	-6.674%	-2.367%	4.989%	5.338%	-1.589%	50.090%	37.315%	23.748%	48.337%	283.157%
RTN	Call	-32.195%	-36.110%	-33.274%	-14.108%	-21.519%	-19.887%	-27.776%	-12.748%	36.198%	53.340%
RTN	Put	-15.266%	9.680%	12.743%	-3.851%	-27.773%	-12.377%	7.335%	0.419%	223.807%	99.381%
SBUX	Call	45.647%	-4.400%	2.015%	-9.927%	-8.803%	105.435%	-5.748%	-9.852%	55.638%	359.576%
SBUX	Put	16.061%	-5.864%	-6.078%	-21.576%	2.767%	40.818%	25.236%	10.262%	31.898%	333.348%
SLB	Call	-11.882%	-7.841%	2.304%	-0.715%	10.794%	17.710%	16.713%	42.885%	125.286%	163.185%
SLB	Put	-5.218%	0.292%	7.710%	-1.750%	-2.947%	47.466%	31.245%	30.636%	130.719%	149.812%
SO	Call	23.164%	49.907%	48.233%	32.769%	26.686%	26.482%	31.419%	32.667%	64.318%	7244.157%
SO	Put	24.466%	52.759%	22.067%	92.913%	9.276%	5.182%	-6.379%	200.309%	71.238%	316.107%
SPG	Call	-26.802%	-27.386%	-20.064%	-37.245%	-25.671%	-5.274%	-19.700%	-3.200%	20.544%	17.894%
SPG	Put	-16.500%	-15.075%	-8.846%	-42.416%	-37.172%	-21.100%	-16.752%	28.558%	38.846%	87.109%
T	Call	-48.143%	-52.515%	-50.284%	-54.728%	-58.355%	-56.923%	-49.425%	-38.955%	-23.939%	-19.836%
T	Put	32.733%	9.837%	-5.308%	-2.182%	4.788%	-0.053%	32.848%	31.985%	58.460%	95.747%
TGT	Call	25.332%	92.852%	-6.898%	-14.560%	-0.976%	-21.828%	227.610%	-11.566%	558.521%	278.721%
TGT	Put	12.537%	5.546%	-4.449%	-9.751%	-8.690%	-17.621%	10.394%	25.160%	115.953%	163.855%
TWX	Call	-11.614%	-21.126%	-9.642%	8.867%	-0.219%	147.469%	21.533%	115.732%	176.799%	208.781%
TWX	Put	-5.288%	-36.667%	-17.567%	-3.056%	0.475%	-1.471%	49.037%	-10.490%	225.372%	217.728%
TXN	Call	13.552%	42.217%	-5.941%	5.628%	16.038%	13.755%	54.157%	41.275%	58.258%	306.618%
TXN	Put	-4.720%	11.125%	-6.594%	-0.671%	2.992%	7.579%	42.008%	25.723%	44.769%	339.145%
UNH	Call	-19.025%	-4.190%	-41.565%	-8.750%	-29.187%	4.949%	30.830%	-6.507%	17.773%	142.325%
UNH	Put	-17.551%	-12.519%	-25.930%	-30.656%	-7.690%	39.838%	35.506%	11.761%	26.497%	92.798%
UNP	Call	-11.861%	-13.259%	14.175%	0.193%	24.071%	10.499%	-2.546%	16.427%	109.696%	141.595%

UNP	Put	-5.359%	-10.140%	-4.521%	15.540%	17.775%	38.596%	-14.060%	-13.678%	89.722%	183.912%
UPS	Call	-1.809%	4.001%	2.229%	6.394%	28.450%	13.412%	-11.524%	9.538%	73.017%	154.749%
UPS	Put	7.113%	5.958%	3.928%	-9.642%	16.575%	33.661%	-4.526%	45.805%	128.404%	199.886%
USB	Call	-4.846%	-3.865%	-19.312%	-5.984%	27.675%	-1.077%	25.730%	21.065%	85.363%	84.916%
USB	Put	4.180%	10.949%	3.694%	-16.216%	39.658%	30.064%	67.920%	36.636%	152.163%	242.770%
UTX	Call	-48.584%	-24.850%	-37.416%	-44.453%	-38.027%	-28.368%	-28.610%	21.323%	65.935%	71.722%
UTX	Put	13.802%	-7.392%	-4.511%	-4.221%	11.779%	9.368%	-2.368%	25.552%	232.083%	152.643%
V	Call	16.988%	-10.763%	-14.101%	-23.189%	-25.247%	-11.313%	-17.527%	-0.835%	42.379%	118.276%
V	Put	13.545%	-23.804%	-28.620%	-29.176%	-32.124%	-16.847%	-33.165%	-32.019%	0.785%	81.971%
WAG	Call	-10.035%	-22.371%	-26.498%	-3.483%	-12.645%	0.419%	9.877%	-12.982%	117.433%	248.144%
WAG	Put	-20.774%	-27.483%	-28.337%	16.209%	26.210%	13.295%	14.703%	58.595%	199.482%	542.444%
WFC	Call	-9.520%	14.891%	27.842%	15.248%	26.646%	23.018%	60.725%	26.519%	117.750%	167.923%
WFC	Put	-8.682%	22.979%	33.807%	-3.629%	-7.018%	30.694%	95.117%	41.139%	99.778%	152.676%
WMB	Call	33.701%	-36.354%	11.070%	177.942%	7.923%	-55.843%	46.571%	-8.547%	81.840%	80.841%
WMB	Put	-18.740%	5.382%	-35.725%	5.272%	42.245%	-27.036%	-4.462%	74.483%	123.142%	114.139%
WMT	Call	-31.505%	-16.524%	637.613%	-23.009%	599.593%	-27.744%	-24.923%	123.866%	101.609%	231.663%
WMT	Put	-14.571%	-28.053%	33.332%	-5.095%	28.479%	-10.411%	9.670%	19.800%	119.667%	152.230%
VZ	Call	-44.693%	-59.254%	-56.745%	-47.372%	-36.276%	-51.292%	-42.530%	-44.542%	-9.600%	1.687%
VZ	Put	15.214%	-17.698%	1.627%	0.807%	8.609%	2.760%	1.443%	6.268%	111.652%	101.122%
XOM	Call	6.230%	0.687%	-4.292%	-20.005%	-11.578%	14.039%	-24.870%	-0.572%	41.791%	35.461%
XOM	Put	26.305%	3.572%	4.599%	-9.964%	6.324%	9.964%	-17.480%	8.266%	57.285%	43.366%